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Evaluating the Noise level at Qazvin University Hospital's Intensive Care Units

Ahmad Nikpey [1]; Mehran Ghalenoei [1,*]; Ali Safary Variani [1]; Hamed Nadri [2]

[1]Department of Occupational Health, Qazvin University of Medical Sciences, Qazvin, IR Iran
[2]Department of Occupational Health, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Mehran Ghalenoei, Department of Occupational Health, Qazvin University of Medical Sciences, Qazvin, IR Iran. Tel: +98-2833328212, Fax: +98-2833345862, E-mail: ghalenoy@gmail.com

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Background: Noise at Intensive Care Units (ICU) has an adverse effect on patients and ICU staff. There are some evidences that sleep, recovery from critical illness and average background noise in hospitals as recommended by the US Environmental Protection Agency (EPA) and World Health Organization (WHO) should not exceed 30 A-weighted decibel (dBA) and peaks during night time should be less than 40 dBA. This survey was conducted to measure noise levels and their relationship with the time of the day and location in the ICU.
Objectives: The objectives of this study were to measure noise levels and evaluate their relationship with time of day and location in the ICU.
Materials and Methods: This cross sectional study was conducted in a public university hospital, namely Qazvin University of Medical Sciences, Qazvin, Iran. Noise levels were measured with SLM Sound level meter (model: Tes-1443) during 24 hours with the equivalent sound level (LEQ), maximum (Max) and peak sound pressure based on the ISO 9612.this tool can measure in the range of 30 to 110 dB dynamic network. While frequency A, fast time scale networks with 125 ms fast response microphones were selected. This method says that measuring point must have distance 1.5 meter from the wall at a height of 1.25 m above ground level. At the bedside of patients measurement done by 3 TES model 1353 H Tool by a Taiwanese company.
Results: This survey showed that the Equivalent Sound Level (Leq) in ICU was much higher than the standard level. The Maximum Sound Level (Lmax) in most places was 84 - 89 dBA and just in one measurement in the Internal ICU reached 90 dB. The average level of Leq in ICU was 70 dB.
Conclusions: Equivalent noise level and Noise Criteria in ward remarkably exceeds the standards levels. This condition will be produce Dangerous circumstances for admitted patients in ward.

Keywords: Hospital; Intensive Care Unit; Noise; Criteria

1. Background

Taking advantage of technology advances and achievements in the field of hospital medicine is increased noise pollution in the hospital units. Moderate noise level in day or night in the care environments has the annual growth rate of 38.0 and 42.0 dB A network in the 1960s (1). Average daily environmental equivalent sound level of 57 dB at the local hospital in 1960 has increased in 2005 to 72 dB peak sound levels of 90 - 85 dB (1, 2). A similar situation has been reported in night shifts and weekends so that the middle of the night sound level of 42 dB in 1960 reached to 60 dB in 2005 (1). Intensive care unit (ICU) of a hospital is an important part of that new method of surgical treatment that is not useful without ICU (3-5). Patients hospitalized in ICU, were not able to take care of themselves and staying in intensive care as a patient is considered a stressful event in patient's life. Environmental factors such as noise, lighting, limited mobility and social isolation have been reported as the main causes of stress in the ICU, in which the noise is a special place (6). Moore and colleagues in a study reported noise pollution as the most important cause painful irritation and an increased need for housing in the hospital during the period (7). Noise exposure increases anxiety, stress and fatigue in hospital employees, so calm voice in the ICU is necessary for patients and also the medical team. Health care team will experience less physical and mental stress and will reduce medical errors to achieve patients faster recovery (8). Sound sources are various in ICU including staff speech, TV, medical equipment such as a ventilator, monitoring, suctioning, nebulizer, telephone, air conditioner and. (2, 8, 9). According to the one study, in order to avoid disrupting sleep and communication skills and stress reduction, the maximum pressure level in a patient's room should not exceed 40 dB. Frequency Weighting Curves (NC) represents the acoustic feature of space interior spaces that fits the place applicability. The recommended frequency weighting curves for ICU 30 - 25 which is equivalent to the noise level of 40 - 35 dB is the

Table 1. Comparison of Indoor Parameters Audio Sound Level at Different Times of Day Hospital

	Noise (A)	Minimum (A)	Maximum (A)	Peak (A)	Confidence Interval (0.05)
Total Shift	60.41	55.85	76.13	92.14	-
7 - 14	62.29	56.08	79.08	95.69	0.00
14 - 20	60.51	56.95	74.63	90.45	0.00
20 - 7	59.05	55	74.97	92.01	0.00

A weighting (10). Otenio et al. in a study categorized the hospitals in three groups based on the level of internal noise with the quiet sound level of 50 - 40, 60 - 50, and the average sound level of 70 - 60 dB with crowded hospitals in the network A (8). Abbasi et al. reported equivalent sound level in the Intensive Care Unit of the hospital affiliated to Isfahan University of Medical Sciences in 2010 and the same on different days in A network of about 64 dB (11). Another study of sound levels was reported in the emergency department, intensive care and hospital departments of Nephrology and Transplantation, Imam Reza (AS) in Mashhad, respectively, 60.2, 57, 63.5 dB A network (12).

2. Objectives

This study aimed to determine the equivalent noise level, minimum and peak frequency weighting curves of normal working days in intensive care in a public hospital of Qazvin University of Medical Sciences in 2010.

3. Materials and Methods

This study measures the equivalent sound level, maximum and peak sound pressure based on ISO 9612 in the range of 30 to 110 dB dynamic network but the frequency A, the fast time scale networks with 125 ms fast response microphones were followed. It measure the distance from the 1.5 meter from the wall at a height of 1.25 m above ground level at the bedside of patients by 3 scale model 1353 H apparatus from Taiwan company TES. The data were consistent with the record. 12 - 8 per hour audio samples were collected at fixed stations. Samples were collected every 5 minutes. To calculate the frequency weighting curves rooms, analyze frequency of 63 Hz to 8000 Hz frequency Sound Level Meter Cel 450 was done by machine. Voice frequency weighting curves were calculated using online software. Calibration of Instruments in TES-1356 was performed using calibrators. Data were analyzed from the Mini tab software version 16 with a one-sided t-test, two-sided 95% confidence level, assuming independent samples.

4. Results

The ICU under study had length of 13 and a width of 7 meters and a height of 3 meters and a height of two meters from the floor made of ceramic floor and had eight beds. Each bed is equipped with a ventilator and a heart monitoring machine. 6 nurses and 3 crew members and 4 nurses and 2 in morning and evening crews were working the night shift. Equivalent noise level, minimum, maximum and peak shifts at all hours were beyond the recommended limits of 35 dB. Equivalent noise level changes, the maximum, minimum, peak at different times of the day is presented in Figure 2 and Table 1. Comparison of noise levels, minimum, maximum, and peak in the period 14 - 7, 20 - 14 and 7 - 20 with the same audio parameters of shifts with 95% confidence represents the same acoustic conditions in different work shifts the ICU ward. Frequency weighting curves at different hours of the day are presented in Figure 3.

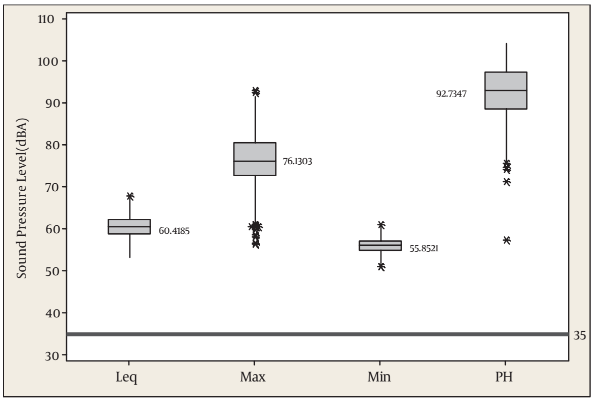

Figure 1. Changes in the Equivalent Sound Level, Maximum, Minimum, and Peak by 95% Compared to the Recommended Level of 35 dB A Network for Indoor Hospital

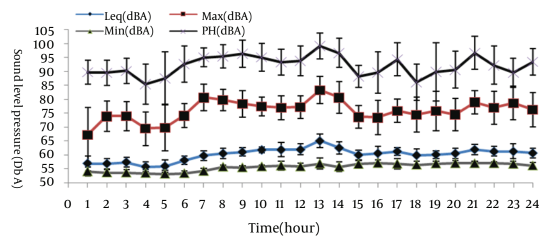

Figure 2. Equivalent Noise Level Changes, the Minimum, Maximum and Peak (dB A) in the ICU Shifts at Different Times

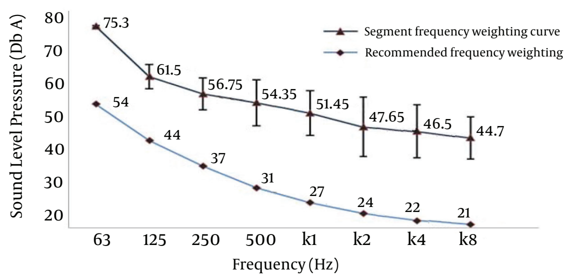

Figure 3. Frequency Weighting Curve Segment and its Variations in Different Frequency Than the Frequency Weighting curves 25NC: During the Shift

5. Discussion

Equivalent sound levels and daily maximum 41/60 and 13/76 dB A network was good correlation with the equivalent sound level (2/60) and the maximum volume (86 to 85) dB A network of care Rza' special hospital in Mashhad in 1388 and voice level of 64 dB A network is in state hospitals in Isfahan in 1389 (11, 12). The difference in results may be due to differences in methods and measuring instruments. We measure the equivalent sound levels and related parameters using continuous scale with the ability to record data in 5 minutes was done. Similar situations by Freedman and colleagues reported that the level of sound equivalent to a day and night, respectively 1/59 and 8/56 and the level of noise peak shifts, day and night, respectively, 9/85 and 8/82 dB on channel A (13). Frequency weighting curves calculated in this study was equivalent to 57 frequency weighting curves that significant amounts of the recommended frequency weighting curve is 30 - 25. Equivalent sound level and frequency weighting curves differed significantly with the tense situation around the recommended section imposes on patients. Comparison of these results with Otenio and colleagues confirms that this group is in public hospital intensive care unit (8). Higher levels of voices and other audio parameters in 13-12 hours mainly are due to washing and cleaning with disinfectants. When cleaning section on room air and removable bucket containing disinfectants, personal conversations, and opening and closing the doors, the sound level was increased. Acoustic parameters of the time compared with the time before the 95% confidence level reflects the impact of the wash room and other audio parameters other than the sound of the voice parameters was minimal. Equivalent sound level of environmental and traffic on Main Street and the streets around the hospital index respectively 22.70 and 7.69 dB A network that permits a uniform sound level, sound environmental events around the hospital is a non-event (14). The distance between the ICU and the total equivalent noise level of the street and shift smoothness, balance, surround sound effect and not the equivalent sound level is mainly due to internal sources. There are several sources of noise in the intensive care unit. On the floor, cleaning equipment, and ventilation during cleaning, removable devices, radiological, hand wheels, carrying bedding, dealing in drug transport wheels, broken doors, two door sections, replacement flat after admission the patient died new patients were determined. Resources, equipment, or human origin are generally sound. Some equipment such as respirators or heart monitoring, listening devices are to ensure the health. The second groups of human origin are sounds that are easily corrected. Christensen, Kahn and colleagues and Sasol The importance of personal conversations between audio sources in the ICU unit, respectively 25, 26 and 18% reported. Accordingly, the most important action for noise control in the ICU is due to noise in the building sector (15-17). Through a variety of sound sources, volume control can be studied from different aspects. Use of low noise equipment and noise levels or detract from existing equipment is one way of reducing noise pollution. Encourage staff to observe the training and close the door quietly, talk gently and avoid noisy work considerably better than the sound of the impact (8). Monsen et al. in a study of educational sessions on ways to reduce noise pollution, a significant reduction in noise levels neurosurgical ICU were reported (18). Another effective strategy in controlling the levels of sound absorption is considered. In a study using fiberglass acoustic panels on the ceiling and walls of the oncology section 5 dB of ambient noise level was reduced (19, 20).

Authors' Contributions

Study concept and design: Dr. Ahmad Nikpey, and Mr. Mehran Ghalenoei. Data collection: Mr. Hamed Nadri. Analysis and interpretation of data: Dr. Ahmad Nikpey, Dr. Ali Safary Variani and Mr. Mehran Ghalenoei. Drafting of the manuscript: Dr. Ahmad Nikpey and Mr. Hamed Nadri. Critical revision of the manuscript for important intellectual content: Mehran Ghalenoei, Ahmad Nikpey, Ali Safary Variani and Hamed Nadri. Statistical analysis: Dr. Ahmad Nikpey and Mr. Mehran Ghalenoei.

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